







# RADIO TEST REPORT

## Test Report No. 14498658M-A-R1

Customer	KAGA FEI Co., Ltd.
Description of EUT	Bluetooth low energy / ANT Module
Model Number of EUT	EC2832
FCC ID	2A6NFEC2832
Test Regulation	FCC Part 15 Subpart C
Test Result	Complied (Refer to SECTION 3)
Issue Date	November 16, 2022
Remarks	- For Permissive Change - Radiated Spurious Emission test only

Representative Test Engineer	Approved By
	
Hiromitsu Tanabe Engineer	Kazuhiro Ando Engineer
	 
	CERTIFICATE 1266.01
<input type="checkbox"/> The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan, Inc.	
<input checked="" type="checkbox"/> There is no testing item of "Non-accreditation".	

Report Cover Page - Form-ULID-003532 (DCS:13-EM-F0429) Issue# 21.0

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- The results in this report apply only to the sample tested. (Laboratory was not involved in sampling.)
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- The all test items in this test report are conducted by UL Japan, Inc Kashima EMC Lab.
- The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan, Inc. has been accredited.
- The information provided from the customer for this report is identified in Section 1.
- For test report(s) referred in this report, the latest version (including any revisions) is always referred.

## **REVISION HISTORY**

### **Original Test Report No.: 14498658M-A**

This report is a revised version of 14498658M-A. 14498658M-A is replaced with this report.

Revision	Test Report No.	Date	Page Revised Contents
- (Original)	14498658M-A	November 8, 2022	-
1	14498658M-A-R1	November 16, 2022	<u>Page 2 to End of Report</u> Corrected the report footer

**Reference: Abbreviations (Including words undescribed in this report)**

A2LA	The American Association for Laboratory Accreditation	ICES	Interference-Causing Equipment Standard
AC	Alternating Current	IEC	International Electrotechnical Commission
AFH	Adaptive Frequency Hopping	IEEE	Institute of Electrical and Electronics Engineers
AM	Amplitude Modulation	IF	Intermediate Frequency
Amp, AMP	Amplifier	ILAC	International Laboratory Accreditation Conference
ANSI	American National Standards Institute	ISED	Innovation, Science and Economic Development Canada
Ant, ANT	Antenna	ISO	International Organization for Standardization
AP	Access Point	JAB	Japan Accreditation Board
ASK	Amplitude Shift Keying	LAN	Local Area Network
Atten., ATT	Attenuator	LIMS	Laboratory Information Management System
AV	Average	MCS	Modulation and Coding Scheme
BPSK	Binary Phase-Shift Keying	MRA	Mutual Recognition Arrangement
BR	Bluetooth Basic Rate	N/A	Not Applicable
BT	Bluetooth	NIST	National Institute of Standards and Technology
BT LE	Bluetooth Low Energy	NS	No signal detect.
BW	BandWidth	NSA	Normalized Site Attenuation
Cal Int	Calibration Interval	NVLAP	National Voluntary Laboratory Accreditation Program
CCK	Complementary Code Keying	OBW	Occupied Band Width
Ch., CH	Channel	OFDM	Orthogonal Frequency Division Multiplexing
CISPR	Comite International Special des Perturbations Radioelectriques	P/M	Power meter
CW	Continuous Wave	PCB	Printed Circuit Board
DBPSK	Differential BPSK	PER	Packet Error Rate
DC	Direct Current	PHY	Physical Layer
D-factor	Distance factor	PK	Peak
DFS	Dynamic Frequency Selection	PN	Pseudo random Noise
DQPSK	Differential QPSK	PRBS	Pseudo-Random Bit Sequence
DSSS	Direct Sequence Spread Spectrum	PSD	Power Spectral Density
EDR	Enhanced Data Rate	QAM	Quadrature Amplitude Modulation
EIRP, e.i.r.p.	Equivalent Isotropically Radiated Power	QP	Quasi-Peak
EMC	ElectroMagnetic Compatibility	QPSK	Quadri-Phase Shift Keying
EMI	ElectroMagnetic Interference	RBW	Resolution Band Width
EN	European Norm	RDS	Radio Data System
ERP, e.r.p.	Effective Radiated Power	RE	Radio Equipment
EU	European Union	RF	Radio Frequency
EUT	Equipment Under Test	RMS	Root Mean Square
Fac.	Factor	RSS	Radio Standards Specifications
FCC	Federal Communications Commission	Rx	Receiving
FHSS	Frequency Hopping Spread Spectrum	SA, S/A	Spectrum Analyzer
FM	Frequency Modulation	SG	Signal Generator
Freq.	Frequency	SVSWR	Site-Voltage Standing Wave Ratio
FSK	Frequency Shift Keying	TR	Test Receiver
GFSK	Gaussian Frequency-Shift Keying	Tx	Transmitting
GNSS	Global Navigation Satellite System	VBW	Video BandWidth
GPS	Global Positioning System	Vert.	Vertical
Hori.	Horizontal	WLAN	Wireless LAN

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## **SECTION 1: Customer Information**

Company Name	KAGA FEI Co., Ltd.
Address	Gunseisha ANNEX Bldg. 5th floor, 382-1, Kaminamie-machi, Takasaki 370-0801 Japan
Telephone Number	+81-27-381-5797
Contact Person	Mikio Aoki

The information provided from the customer is as follows;

- Customer, Description of EUT, Model Number of EUT, FCC ID on the cover and other relevant pages
  - Operating/Test Mode(s) (Mode(s)) on all the relevant pages
  - SECTION 1: Customer Information
  - SECTION 2: Equipment Under Test (EUT) other than the Receipt Date and Test Date
  - SECTION 4: Operation of EUT during testing
- \* The laboratory is exempted from liability of any test results affected from the above information in SECTION 2 and 4.

## **SECTION 2: Equipment Under Test (EUT)**

### **2.1 Identification of EUT**

Description	Bluetooth low energy / ANT Module
Model Number	EC2832
Serial Number	Refer to SECTION 4.2
Condition	Engineering prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	No Modification by the test lab
Receipt Date	September 29, 2022
Test Date	October 14, 2022

### **2.2 Product Description**

#### **General Specification**

Rating	DC 3 V, DC 1.7 V to 3.6 V, 0.02 A, 0.1 W
Operating temperature	-40 deg. C to 85 deg. C

#### **Radio Specification**

##### **<Bluetooth (BT) Low Energy (LE)>**

Radio Type	Transceiver
Frequency of Operation	2402 MHz - 2480 MHz
Modulation	GFSK
Antenna Gain	-2.6 dBi

##### **<ANT>**

Radio Type	Transceiver
Frequency of Operation	2402 MHz - 2480 MHz
Modulation	GFSK
Antenna Gain	-2.6 dBi

##### **<Nordic Original>**

Radio Type	Transceiver
Frequency of Operation	2402 MHz - 2480 MHz
Modulation	GFSK
Antenna Gain	-2.6 dBi

## SECTION 3: Test Specification, Procedures & Results

### 3.1 Test Specification

Test Specification	FCC Part 15 Subpart C The latest version on the first day of the testing period
Title	FCC 47 CFR Part 15 Radio Frequency Device Subpart C Intentional Radiators Section 15.207 Conducted limits Section 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz

### 3.2 Procedures and Results

Item	Test Procedure	Specification	Worst Margin	Results	Remarks
Spurious Emission Restricted Band Edges	FCC: KDB 558074 D01 15.247 Meas Guidance v05r02	FCC: Section 15.247(d)	4.6 dB 7206.000 MHz, AV, Horizontal	Complied a)	Radiated (above 30 MHz) *1)
	ISED: RSS-Gen 6.13	ISED: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10			
Note: UL Japan, Inc.'s EMI Work Procedures: Work Instructions-ULID-003591 and Work Instructions-ULID-003593. * In case any questions arise about test procedure, ANSI C63.10: 2013 is also referred.					
*1) Radiated test was selected over 30 MHz based on section 15.247(d) and KDB 558074 D01 15.247 Meas Guidance v05r02 8.5 and 8.6.					
a) Refer to APPENDIX 1 (data of Radiated Spurious Emission)					

#### **FCC Part 15.31 (e)**

This EUT provides the stable voltage constantly to RF Module regardless of input voltage.  
Therefore, this EUT complies with the requirement.

#### **FCC Part 15.203/212 Antenna requirement**

It is impossible for end users to replace the antenna, because the antenna is mounted inside of the EUT.  
Therefore, the equipment complies with the antenna requirement of Section 15.203/212.

### 3.3 Addition to Standard

No addition, exclusion nor deviation has been made from the standard.

### 3.4 Uncertainty

Measurement uncertainty is not taken into account when stating conformity with a specified requirement.  
Note: When margins obtained from test results are less than the measurement uncertainty, the test results may exceed the limit.

The following uncertainties have been calculated to provide a confidence level of 95 % using a coverage factor  $k = 2$ .

#### **Radiated emission**

Measurement distance	Frequency range	Required Uncertainty (+/-)	Uncertainty (+/-)
3 m	9 kHz to 30 MHz	Not Defined	2.9 dB
	30 MHz to 200 MHz	6.3 dB	6.1 dB
	200 MHz to 1000 MHz		6.2 dB
	1 GHz to 6 GHz	5.2 dB	5.0 dB
	6 GHz to 18 GHz	5.5 dB	5.4 dB
	18 GHz to 40 GHz	Not Defined	5.5 dB
1 m	1 GHz to 18 GHz	Not Defined	5.4 dB
	18 GHz to 40 GHz		5.6 dB
0.5 m	26.5 GHz to 40 GHz	Not Defined	5.9 dB

### 3.5 Test Location

UL Japan, Inc. Kashima EMC Lab.  
1614 Mushihata, Katori-shi, Chiba-ken, 289-0341 Japan  
Telephone: +81 478 88 6500

A2LA Certificate Number: 1266.01 / FCC Test Firm Registration Number: 910230  
ISED Lab Company Number: 4659A / CAB identifier: JP0006

Test site	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
No.1 Open site	6.0 x 5.5 x 2.5	20 x 40	10 m
No.5 Open site	8.6 x 7.1 x 2.4	18 x 23	10 m
No.1 Shielded room	5.4 x 4.5 x 2.3	-	-
No.5 Shielded Room	4.2 x 3.1 x 2.5	-	-
No.9 Shielded Room	6.1 x 3.6 x 2.8	-	-
No.6 Semi-anechoic Chamber	8.5 x 5.5 x 5.2	-	3 m
No.10 Semi-anechoic Chamber	18.4 x 9.9 x 7.7	-	10 m
No.11 Semi-anechoic Chamber	9.0 x 6.5 x 5.2	-	3 m
No.1 Measurement room	5.0 x 3.7 x 2.6	-	-
No.2 Measurement room	4.3 x 4.4 x 2.7	-	-
No.3 Measurement room	4.5 x 5.3 x 2.7	-	-

### 3.6 Test Data, Test Instruments, and Test Set Up

Refer to APPENDIX.

## **SECTION 4: Operation of EUT during testing**

### **4.1 Operating Mode(s)**

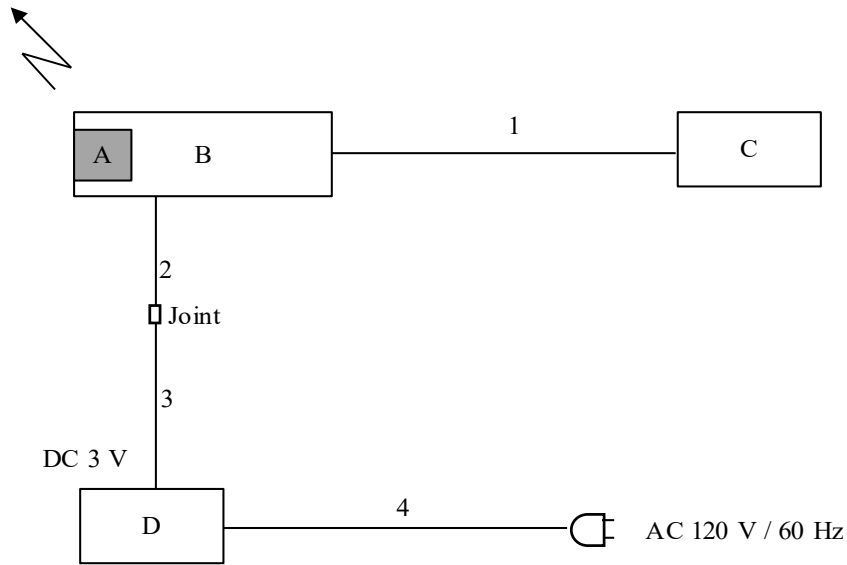
<b>Mode</b>	<b>Remarks*</b>
ANT	1 Mbps
Nordic Original	2 Mbps
Bluetooth Low Energy (BLE) 1M-PHY	Maximum Packet Size, PRBS9
Bluetooth Low Energy (BLE) 2M-PHY	Maximum Packet Size, PRBS9
<p>*Power of the EUT was set by the software as follows;            Power Setting: +4 dBm            Software: Radio_test_tool_2022v1_64bit            (Date: June 22, 2022, Storage location: Driven by connected PC)</p> <p>*This setting of software is the worst case.            Any conditions under the normal use do not exceed the condition of setting.            In addition, end users cannot change the settings of the output power of the product.</p>	

\*The Details of Operating Mode(s)

<b>Test Item</b>	<b>Operating Mode *1)</b>	<b>Tested frequency</b>
Radiated Spurious Emission (Below 1 GHz)	Tx ANT	2402 MHz
Radiated Spurious Emission (Above 1 GHz)	Tx ANT	2402 MHz 2441 MHz 2480 MHz
	Tx Nordic Original	2402 MHz *2)
	Tx BLE, 1M-PHY Tx BLE, 2M-PHY	2480 MHz *2)
<p>*1) The operating mode and tested frequency were tested as a representative, because it had the highest power at antenna terminal test.            *2) Band-edge only</p>		



## 4.2 Configuration and Peripherals



\* Cabling and setup(s) were taken into consideration and test data was taken under worse case conditions.

### Description of EUT and Support Equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Bluetooth low energy / ANT Module	EC2832	27	KAGA FEI Co., Ltd.	EUT
B	Evaluation Board	EC2832AA1-EVB	-	KAGA FEI Co., Ltd.	-
C	Laptop PC	FMVS02001	R5401340	FUJITSU	-
D	DC Power Supply	GSV3000	2010221559	DIAMOND ANTENNA	-

### List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	USB Cable	1.8	Shielded	Shielded	-
2	DC Cable	0.5	Unshielded	Unshielded	-
3	DC Cable	1.2	Unshielded	Unshielded	-
4	AC Cable	1.7	Unshielded	Unshielded	-

## **SECTION 5: Radiated Spurious Emission**

### **Test Procedure**

It was measured based on "8.5 and 8.6 of KDB 558074 D01 15.247 Meas Guidance v05r02".

[For below 1 GHz]

EUT was placed on a urethane platform of nominal size, 0.5 m by 0.5 m, raised 0.8 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

[For above 1 GHz]

EUT was placed on a urethane platform of nominal size, 0.5 m by 0.5 m, raised 1.5 m above the conducting ground plane.

The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with absorbent materials lined on a ground plane.

The height of the measuring antenna varied between 1 m and 4 m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field strength.

Test antenna was aimed at the EUT for receiving the maximum signal and always kept within the illumination area of the 3 dB beamwidth of the antenna.

The measurements were performed for both vertical and horizontal antenna polarization with the Test Receiver, or the Spectrum Analyzer.

The measurements were made with the following detector function of the test receiver and the Spectrum analyzer (in linear mode).

The test was made with the detector (RBW/VBW) in the following table.

When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

### **Test Antennas are used as below;**

Frequency	Below 1 GHz	Above 1 GHz
Antenna Type	Hybrid	Horn

In any 100 kHz bandwidth outside the restricted band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator confirmed 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on a radiated measurement.

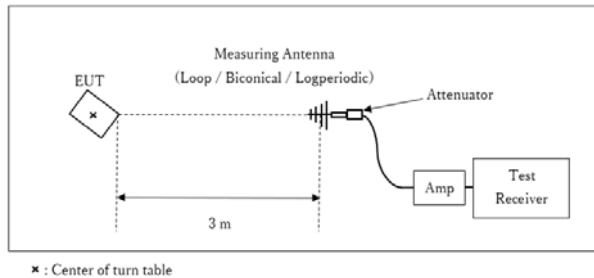
### **20 dBc was applied to the frequency over the limit of FCC 15.209 / Table 4 of RSS-Gen 8.9(ISED) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (ISED).**

Frequency	Below 1 GHz	Above 1 GHz		20 dBc
Instrument used	Test Receiver	Spectrum Analyzer		Spectrum Analyzer
Detector	QP	PK	AV *1)	PK
IF Bandwidth	BW 120 kHz	RBW: 1 MHz VBW: 3 MHz	<u>11.12.2.5.1</u> RBW: 1 MHz VBW: 3 MHz Detector: Power Averaging (RMS) Trace: 100 traces <u>11.12.2.5.2</u> The duty cycle was less than 98% for detected noise, a duty factor was added to the 11.12.2.5.1 results.	RBW: 100 kHz VBW: 300 kHz

\*1) Average Power Measurement was performed based on ANSI C63.10-2013.

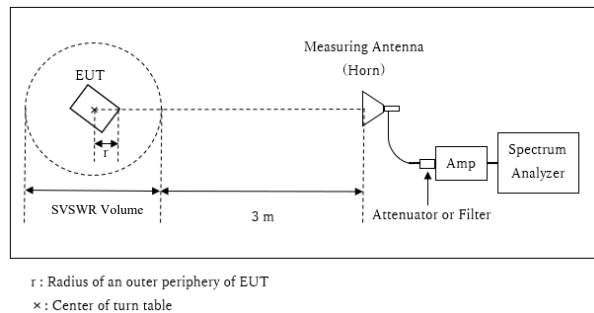
**Figure 2: Test Setup**

Below 1 GHz



Test Distance: 3 m

1 GHz to 10 GHz

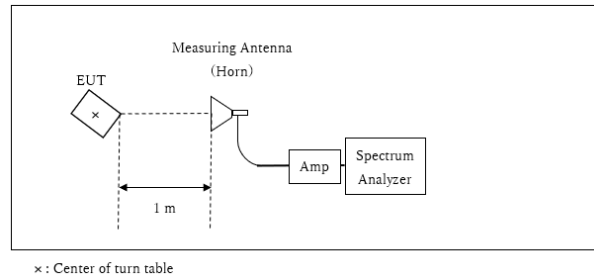


Distance Factor:  $20 \times \log(4.5 \text{ m} / 3.0 \text{ m}) = 3.52 \text{ dB}$   
\* Test Distance:  $(3 + \text{SVSWR Volume} / 2) - r = 4.5 \text{ m}$

SVSWR Volume : 3.0 m  
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)  
 $r = 0.0 \text{ m}$

\* The test was performed with  $r = 0.0 \text{ m}$  since EUT is small and it was the rather conservative condition.

10 GHz to 26.5 GHz



Distance Factor:  $20 \times \log(1.0 \text{ m} / 3.0 \text{ m}) = -9.5 \text{ dB}$   
\* Test Distance: 1 m

- The carrier level and noise levels were confirmed at each position of X, Y and Z axes of EUT to see the position of maximum noise, and the test was made at the position that has the maximum noise.

The test results and limit are rounded off to one decimal place, so some differences might be observed.

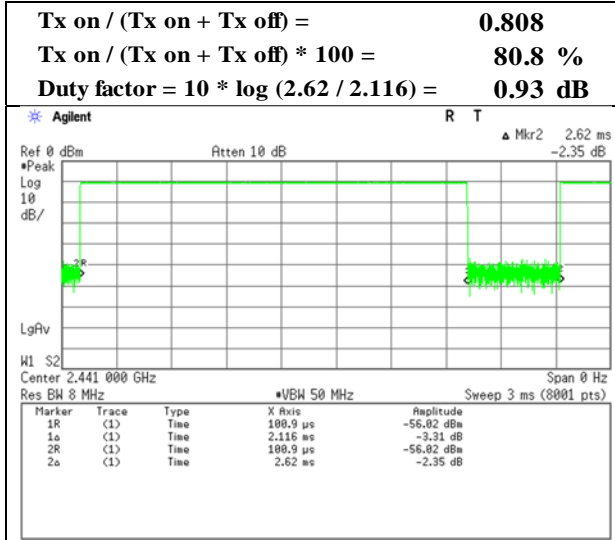
**Measurement Range** : 30 MHz to 26.5 GHz  
**Test Data** : APPENDIX  
**Test Result** : Pass

**APPENDIX 1: Test Data**

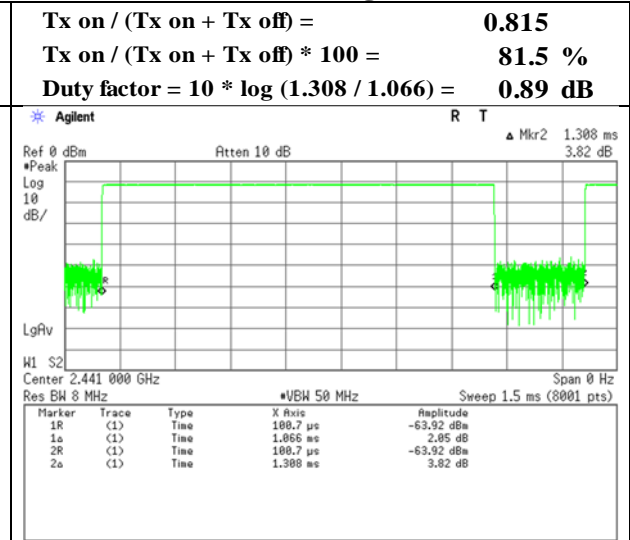
**Burst rate confirmation**

Test place : Kashima EMC Lab. No.10 Semi Anechoic Chamber  
 Date : October 14, 2022  
 Temperature / Humidity : 21 deg. C / 58 % RH  
 Engineer : Hiromitsu Tanabe  
 Mode : Tx

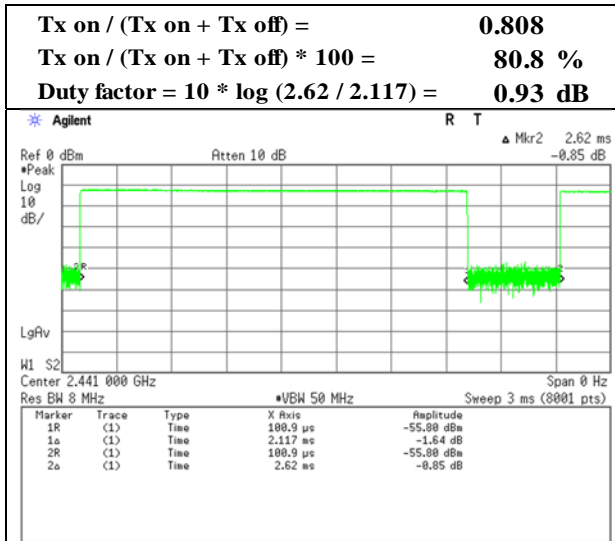
**ANT**



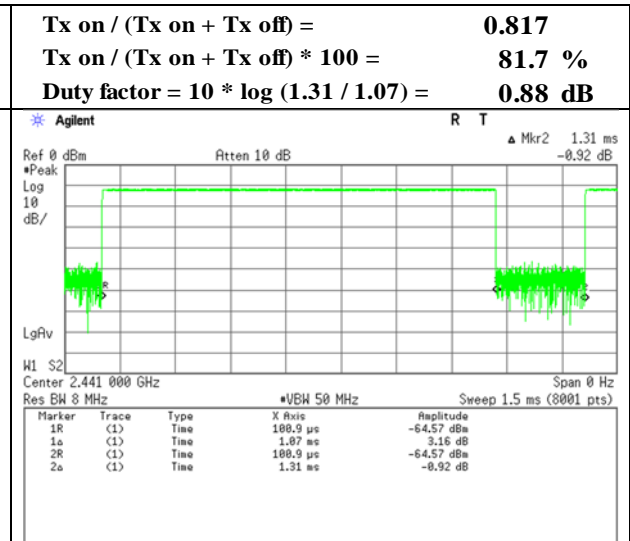
**Nordic Original**



**BLE 1M-PHY**



**BLE 2M-PHY**



\* Since the burst rate is not different between the channels, the data has been obtained on the representative channel.

## Radiated Spurious Emission

Test place	Kashima EMC Lab.			
Semi Anechoic Chamber	No.10	No.10	No.10	No.10
Date	October 14, 2022	October 14, 2022	October 14, 2022	October 14, 2022
Temperature / Humidity	21 deg. C / 58 % RH	21 deg. C / 58 % RH	21 deg. C / 58 % RH	21 deg. C / 58 % RH
Engineer	Hiromitsu Tanabe	Hiromitsu Tanabe	Hiromitsu Tanabe	Hiromitsu Tanabe
Mode	(30 MHz - 1000 MHz) Tx ANT 2402 MHz	(1 GHz - 2.8 GHz)	(2.8 GHz - 10 GHz)	(10 GHz - 26.5 GHz)

(\* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	2390.000	PK	56.80	27.50	13.43	46.21	3.52	55.04	73.9	18.8	262	245	
Hori.	4804.000	PK	55.80	32.54	5.51	45.74	3.52	51.63	73.9	22.2	395	264	
Hori.	7206.000	PK	52.70	37.22	6.74	44.87	3.52	55.31	73.9	18.5	122	112	
Hori.	9608.000	PK	47.80	37.99	7.51	43.24	3.52	53.58	73.9	20.3	150	0	Floor noise
Vert.	32.000	QP	26.20	12.42	5.93	31.62	0.00	12.93	40.0	27.0	100	0	
Vert.	64.000	QP	25.80	12.68	6.45	31.57	0.00	13.36	40.0	26.6	100	0	
Vert.	96.000	QP	28.00	8.35	6.87	31.50	0.00	11.72	43.5	31.7	100	0	
Vert.	128.000	QP	24.80	11.95	7.22	31.45	0.00	12.52	43.5	30.9	100	0	
Vert.	160.000	QP	24.30	13.40	7.55	31.40	0.00	13.85	43.5	29.6	100	0	
Vert.	192.000	QP	24.30	10.37	7.86	31.35	0.00	11.18	43.5	32.3	100	0	
Vert.	2390.000	PK	56.90	27.50	13.43	46.21	3.52	55.14	73.9	18.7	103	42	
Vert.	4804.000	PK	56.10	32.54	5.51	45.74	3.52	51.93	73.9	21.9	214	228	
Vert.	7206.000	PK	53.60	37.22	6.74	44.87	3.52	56.21	73.9	17.6	202	225	
Vert.	9608.000	PK	47.80	37.99	7.51	43.24	3.52	53.58	73.9	20.3	150	0	Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 10 GHz : 20log (4.5 m / 3.0 m) = 3.52 dB

10 GHz - 26.5 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

### Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2390.000	AV	44.40	27.50	13.43	46.21	0.93	3.52	43.57	53.90	10.3	*1)
Hori.	4804.000	AV	48.30	32.54	5.51	45.74	0.93	3.52	45.06	53.90	8.8	
Hori.	7206.000	AV	45.70	37.22	6.74	44.87	0.93	3.52	49.24	53.90	4.6	
Hori.	9608.000	AV	39.00	37.99	7.51	43.24	0.93	3.52	45.71	53.90	8.1	Floor noise
Vert.	2390.000	AV	44.60	27.50	13.43	46.21	0.93	3.52	43.77	53.90	10.1	
Vert.	4804.000	AV	47.90	32.54	5.51	45.74	0.93	3.52	44.66	53.90	9.2	
Vert.	7206.000	AV	45.20	37.22	6.74	44.87	0.93	3.52	48.74	53.90	5.1	
Vert.	9608.000	AV	39.00	37.99	7.51	43.24	0.93	3.52	45.71	53.90	8.1	Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + Distance factor

Distance factor : 1 GHz - 10 GHz : 20log (4.5 m / 3.0 m) = 3.52 dB

10 GHz - 26.5 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

Duty factor refer to "Duty factor Calculation chart" sheet.

\*1) Not out of band emission (Leakage Power)

### 20 dBc Data Sheet (RBW 100 kHz, VBW 300 kHz)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.000	PK	99.40	27.53	13.44	46.20	3.52	97.69	-	-	Carrier
Hori.	2399.630	PK	52.00	27.52	13.44	46.20	3.52	50.28	77.69	27.4	
Hori.	2400.000	PK	51.90	27.52	13.44	46.20	3.52	50.18	77.69	27.5	
Vert.	2402.000	PK	98.70	27.53	13.44	46.20	3.52	96.99	-	-	Carrier
Vert.	2399.650	PK	51.80	27.52	13.44	46.20	3.52	50.08	76.99	26.9	
Vert.	2400.000	PK	51.70	27.52	13.44	46.20	3.52	49.98	76.99	27.0	

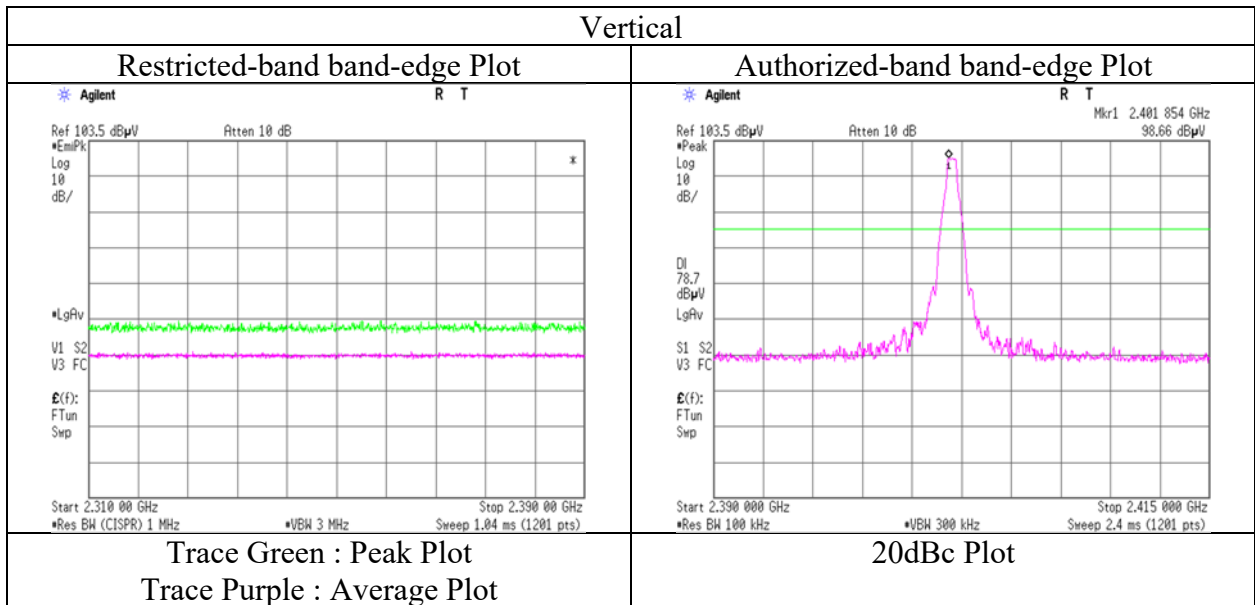
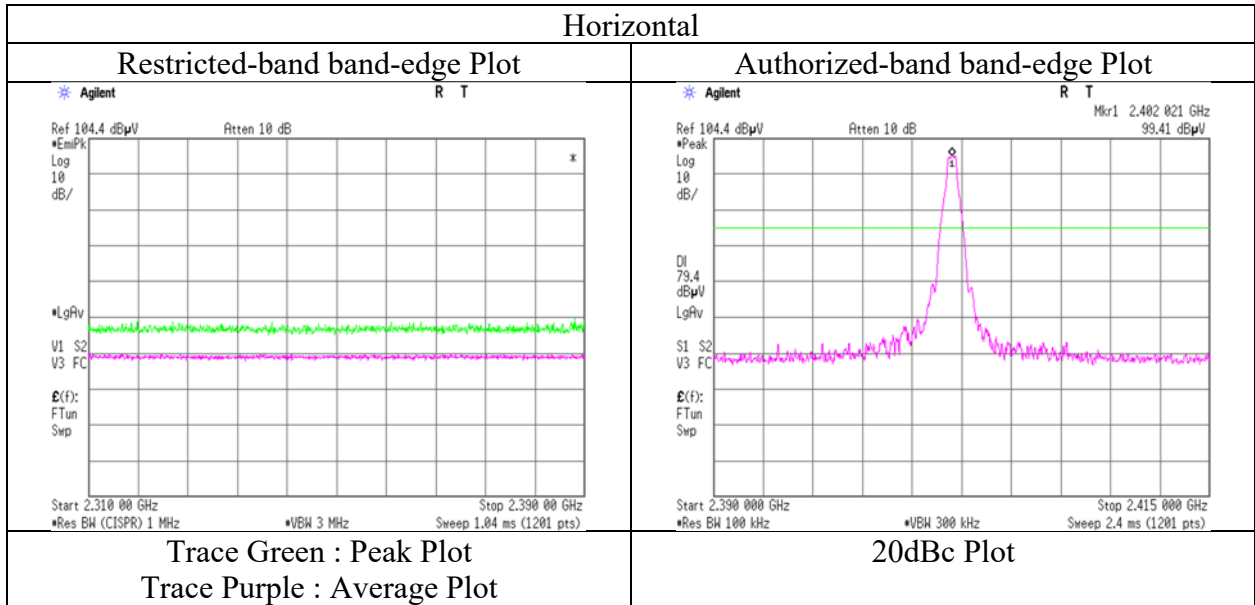
Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 10 GHz : 20log (4.5 m / 3.0 m) = 3.52 dB

10 GHz - 26.5 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

**Radiated Spurious Emission**  
**(Reference Plot for band-edge)**

Test place	Kashima EMC Lab.
Semi Anechoic Chamber	No.10
Date	October 14, 2022
Temperature / Humidity	21 deg. C / 58 % RH
Engineer	Hiromitsu Tanabe
	(1 GHz - 2.8 GHz)
Mode	Tx ANT 2402 MHz



\* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions. Final result of restricted band edge was shown in tabular data.

## Radiated Spurious Emission

Test place	Kashima EMC Lab.		
Semi Anechoic Chamber	No.10	No.10	No.10
Date	October 14, 2022	October 14, 2022	October 14, 2022
Temperature / Humidity	21 deg. C / 58 % RH	21 deg. C / 58 % RH	21 deg. C / 58 % RH
Engineer	Hiromitsu Tanabe	Hiromitsu Tanabe	Hiromitsu Tanabe
Mode	Tx ANT 2441 MHz		(10 GHz - 26.5 GHz)

(\* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	4882.000	PK	53.60	32.56	5.54	45.73	3.52	49.49	73.9	24.4	258	124	
Hori.	7323.000	PK	52.30	37.37	6.75	44.69	3.52	55.25	73.9	<b>18.6</b>	152	122	
Hori.	9764.000	PK	48.20	37.99	7.57	43.16	3.52	54.12	73.9	19.7	150	0	Floor noise
Vert.	4882.000	PK	54.40	32.56	5.54	45.73	3.52	50.29	73.9	23.6	237	218	
Vert.	7323.000	PK	52.20	37.37	6.75	44.69	3.52	55.15	73.9	18.7	171	238	
Vert.	9764.000	PK	47.40	37.99	7.57	43.16	3.52	53.32	73.9	20.5	150	0	Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 10 GHz : 20log (4.5 m / 3.0 m) = 3.52 dB

10 GHz - 26.5 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

### Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	4882.000	AV	45.70	32.56	5.54	45.73	0.93	3.52	42.52	53.90	11.3	
Hori.	7323.000	AV	44.30	37.37	6.75	44.69	0.93	3.52	48.18	53.90	<b>5.7</b>	
Hori.	9764.000	AV	38.60	37.99	7.57	43.16	0.93	3.52	45.45	53.90	8.4	Floor noise
Vert.	4882.000	AV	47.00	32.56	5.54	45.73	0.93	3.52	43.82	53.90	10.0	
Vert.	7323.000	AV	42.70	37.37	6.75	44.69	0.93	3.52	46.58	53.90	<b>7.3</b>	
Vert.	9764.000	AV	38.50	37.99	7.57	43.16	0.93	3.52	45.35	53.90	8.5	Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + Distance factor

Distance factor : 1 GHz - 10 GHz : 20log (4.5 m / 3.0 m) = 3.52 dB

10 GHz - 26.5 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

Duty factor refer to "Duty factor Calculation chart" sheet.

\*1) Not out of band emission (Leakage Power)

## Radiated Spurious Emission

Test place	Kashima EMC Lab.		
Semi Anechoic Chamber	No.10	No.10	No.10
Date	October 14, 2022	October 14, 2022	October 14, 2022
Temperature / Humidity	21 deg. C / 58 % RH	21 deg. C / 58 % RH	21 deg. C / 58 % RH
Engineer	Hiromitsu Tanabe	Hiromitsu Tanabe	Hiromitsu Tanabe
Mode	(1 GHz - 2.8 GHz)	(2.8 GHz - 10 GHz)	(10 GHz - 26.5 GHz)
	Tx ANT 2480 MHz		

(\* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	2483.500	PK	60.80	27.87	13.51	46.12	3.52	59.58	73.90	<b>14.3</b>	148	241	
Hori.	4960.000	PK	54.70	32.66	5.58	45.73	3.52	50.73	73.90	23.1	189	40	
Hori.	7440.000	PK	51.80	37.36	6.78	44.64	3.52	54.82	73.90	19.0	193	118	
Hori.	9920.000	PK	47.60	38.19	7.62	43.23	3.52	53.70	73.90	20.2	150	0	Floor noise
Vert.	2483.500	PK	58.50	27.87	13.51	46.12	3.52	57.28	73.90	<b>16.6</b>	152	61	
Vert.	4960.000	PK	54.70	32.66	5.58	45.73	3.52	50.73	73.90	23.1	121	284	
Vert.	7440.000	PK	51.70	37.36	6.78	44.64	3.52	54.72	73.90	19.1	155	81	
Vert.	9920.000	PK	47.20	38.19	7.62	43.23	3.52	53.30	73.90	20.6	150	0	Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 10 GHz : 20log (4.5 m / 3.0 m) = 3.52 dB

10 GHz - 26.5 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

### Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2483.500	AV	46.20	27.87	13.51	46.12	0.93	3.52	45.91	53.90	7.9	*1)
Hori.	4960.000	AV	46.90	32.66	5.58	45.73	0.93	3.52	43.86	53.90	10.0	
Hori.	7440.000	AV	42.70	37.36	6.78	44.64	0.93	3.52	46.65	53.90	<b>7.2</b>	
Hori.	9920.000	AV	38.40	38.19	7.62	43.23	0.93	3.52	45.43	53.90	8.4	Floor noise
Vert.	2483.500	AV	45.20	27.87	13.51	46.12	0.93	3.52	44.91	53.90	8.9	*1)
Vert.	4960.000	AV	47.00	32.66	5.58	45.73	0.93	3.52	43.96	53.90	9.9	
Vert.	7440.000	AV	42.00	37.36	6.78	44.64	0.93	3.52	45.95	53.90	7.9	
Vert.	9920.000	AV	38.40	38.19	7.62	43.23	0.93	3.52	45.43	53.90	8.4	Floor noise

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + Distance factor

Distance factor : 1 GHz - 10 GHz : 20log (4.5 m / 3.0 m) = 3.52 dB

10 GHz - 26.5 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

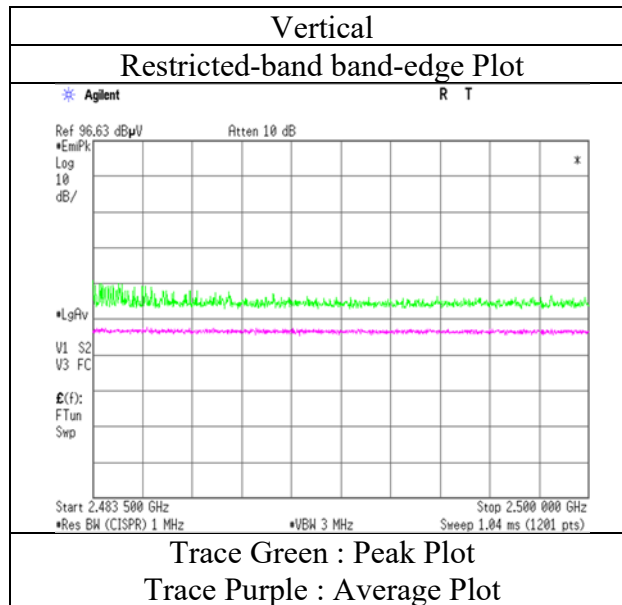
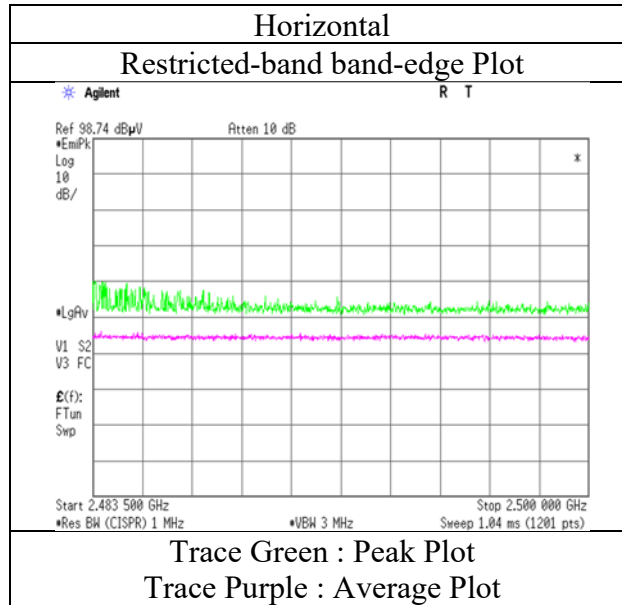
Duty factor refer to "Duty factor Calculation chart" sheet.

\*1) Not out of band emission (Leakage Power)



### Radiated Spurious Emission (Reference Plot for band-edge)

Test place	Kashima EMC Lab.
Semi Anechoic Chamber	No.10
Date	October 14, 2022
Temperature / Humidity	21 deg. C / 58 % RH
Engineer	Hiromitsu Tanabe
	(1 GHz - 2.8 GHz)
Mode	Tx ANT 2480 MHz



\* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions. Final result of restricted band edge was shown in tabular data.

## Radiated Spurious Emission

Test place	Kashima EMC Lab.
Semi Anechoic Chamber	No.10
Date	October 14, 2022
Temperature / Humidity	21 deg. C / 58 % RH
Engineer	Hikomitsu Tanabe (1 GHz - 2.8 GHz)
Mode	Tx Nordic Original 2402 MHz

(\* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	2390.000	PK	56.30	27.50	13.43	46.21	3.52	54.54	73.90	19.3	227	210	
Vert.	2390.000	PK	55.50	27.50	13.43	46.21	3.52	53.74	73.90	20.1	104	41	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor  
 Distance factor : 1 GHz - 10 GHz :  $20\log(4.5\text{ m} / 3.0\text{ m}) = 3.52\text{ dB}$

### Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2390.000	AV	44.70	27.50	13.43	46.21	0.89	3.52	43.83	53.90	10.0	*1)
Vert.	2390.000	AV	44.60	27.50	13.43	46.21	0.89	3.52	43.73	53.90	10.1	*1)

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + Distance factor  
 Distance factor : 1 GHz - 10 GHz :  $20\log(4.5\text{ m} / 3.0\text{ m}) = 3.52\text{ dB}$

Duty factor refer to "Duty factor Calculation chart" sheet.

\*1) Not out of band emission (Leakage Power)

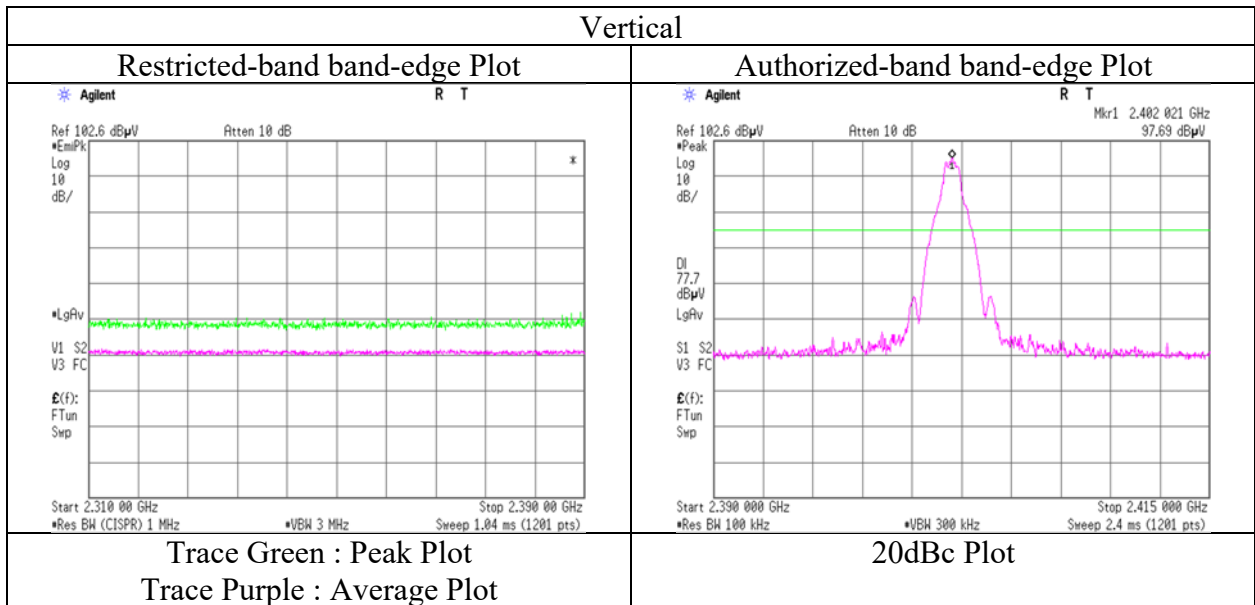
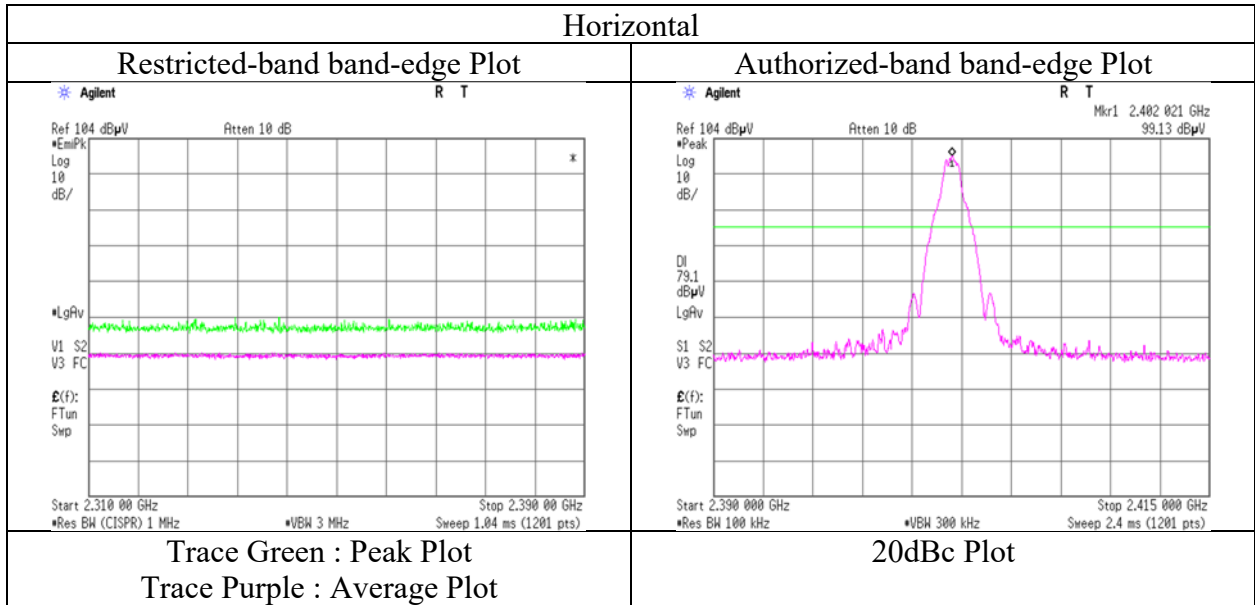
### 20 dBc Data Sheet (RBW 100 kHz, VBW 300 kHz)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.000	PK	99.10	27.53	13.44	46.20	3.52	97.39	-	-	Carrier
Hori.	2400.000	PK	59.40	27.52	13.44	46.20	3.52	57.68	77.39	19.7	
Vert.	2402.000	PK	97.70	27.53	13.44	46.20	3.52	95.99	-	-	Carrier
Vert.	2400.000	PK	57.90	27.52	13.44	46.20	3.52	56.18	75.99	19.8	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor  
 Distance factor : 1 GHz - 10 GHz :  $20\log(4.5\text{ m} / 3.0\text{ m}) = 3.52\text{ dB}$

**Radiated Spurious Emission**  
**(Reference Plot for band-edge)**

Test place	Kashima EMC Lab.
Semi Anechoic Chamber	No.10
Date	October 14, 2022
Temperature / Humidity	21 deg. C / 58 % RH
Engineer	Hiromitsu Tanabe
	(1 GHz - 2.8 GHz)
Mode	Tx Nordic Original 2402 MHz



\* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions. Final result of restricted band edge was shown in tabular data.

## Radiated Spurious Emission

Test place	Kashima EMC Lab.
Semi Anechoic Chamber	No.10
Date	October 14, 2022
Temperature / Humidity	21 deg. C / 58 % RH
Engineer	Hikomitsu Tanabe (1 GHz - 2.8 GHz)
Mode	Tx Nordic Original 2480 MHz

(\* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	2483.500	PK	60.00	27.87	13.51	46.12	3.52	58.78	73.90	15.1	151	247	
Vert.	2483.500	PK	59.60	27.87	13.51	46.12	3.52	58.38	73.90	15.5	150	310	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor  
 Distance factor : 1 GHz - 10 GHz :  $20\log(4.5\text{ m} / 3.0\text{ m}) = 3.52\text{ dB}$

**Average measurement value with duty factor**

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2483.500	AV	45.70	27.87	13.51	46.12	0.89	3.52	45.37	53.90	8.5	*1)
Vert.	2483.500	AV	45.00	27.87	13.51	46.12	0.89	3.52	44.67	53.90	9.2	*1)

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + Distance factor

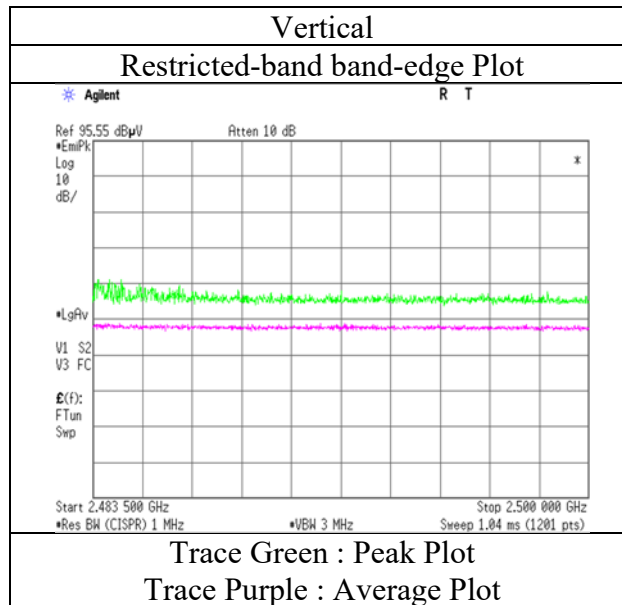
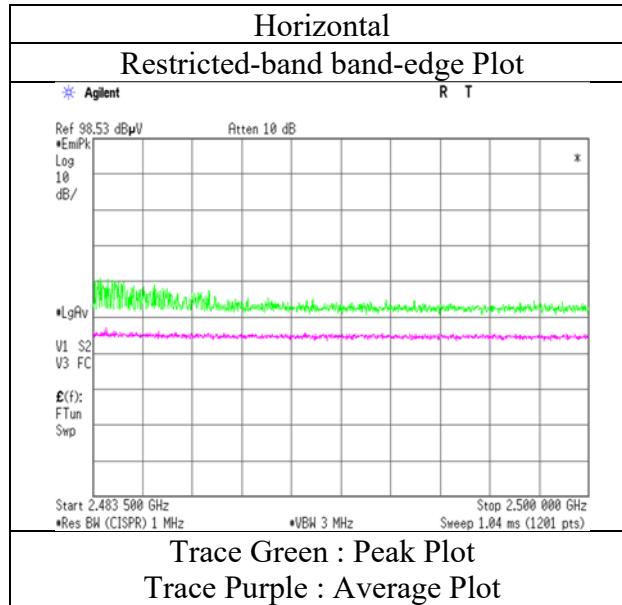
Distance factor : 1 GHz - 10 GHz :  $20\log(4.5\text{ m} / 3.0\text{ m}) = 3.52\text{ dB}$

Duty factor refer to "Duty factor Calculation chart" sheet.

\*1) Not out of band emission (Leakage Power)

### Radiated Spurious Emission (Reference Plot for band-edge)

Test place	Kashima EMC Lab.
Semi Anechoic Chamber	No.10
Date	October 14, 2022
Temperature / Humidity	21 deg. C / 58 % RH
Engineer	Hiromitsu Tanabe (1 GHz - 2.8 GHz)
Mode	Tx Nordic Original 2480 MHz



\* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions. Final result of restricted band edge was shown in tabular data.

## Radiated Spurious Emission

Test place	Kashima EMC Lab.
Semi Anechoic Chamber	No.10
Date	October 14, 2022
Temperature / Humidity	21 deg. C / 58 % RH
Engineer	Hikomitsu Tanabe (1 GHz - 2.8 GHz)
Mode	Tx BLE 1M-PHY 2402 MHz

(\* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	2390.000	PK	55.30	27.50	13.43	46.21	3.52	53.54	73.9	20.3	229	207	
Vert.	2390.000	PK	56.30	27.50	13.43	46.21	3.52	54.54	73.9	19.3	147	43	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor  
 Distance factor : 1 GHz - 10 GHz :  $20\log(4.5\text{ m} / 3.0\text{ m}) = 3.52\text{ dB}$

### Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2390.000	AV	44.50	27.50	13.43	46.21	0.93	3.52	43.67	53.9	10.2	*1)
Vert.	2390.000	AV	44.70	27.50	13.43	46.21	0.93	3.52	43.87	53.9	10.0	*1)

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + Distance factor  
 Distance factor : 1 GHz - 10 GHz :  $20\log(4.5\text{ m} / 3.0\text{ m}) = 3.52\text{ dB}$

Duty factor refer to "Duty factor Calculation chart" sheet.

\*1) Not out of band emission (Leakage Power)

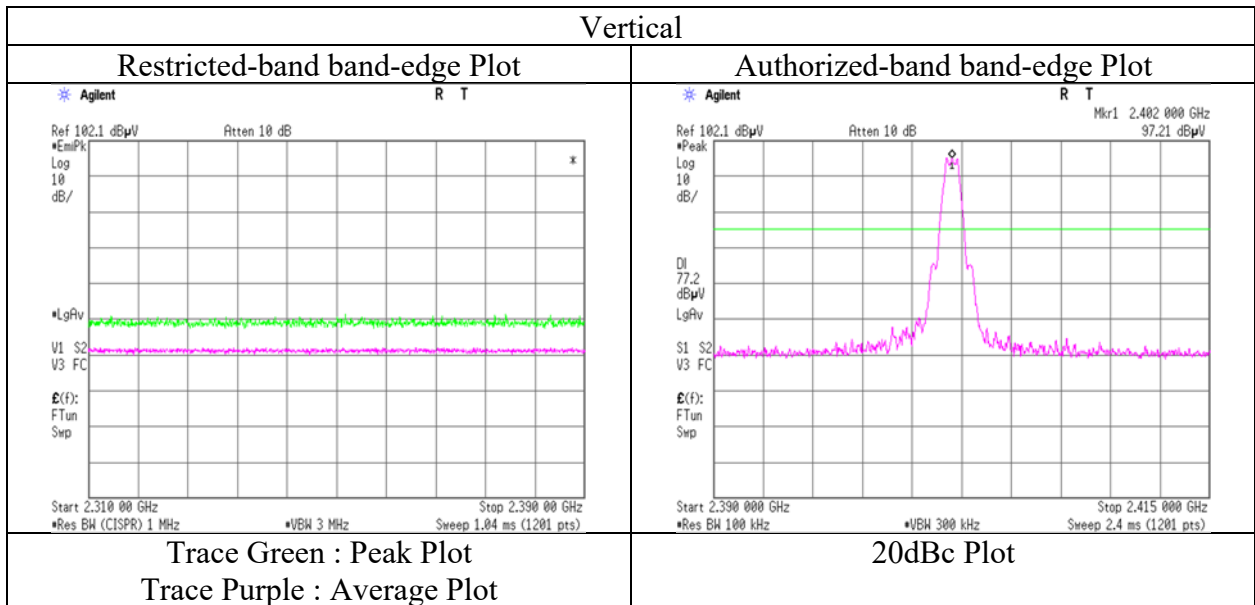
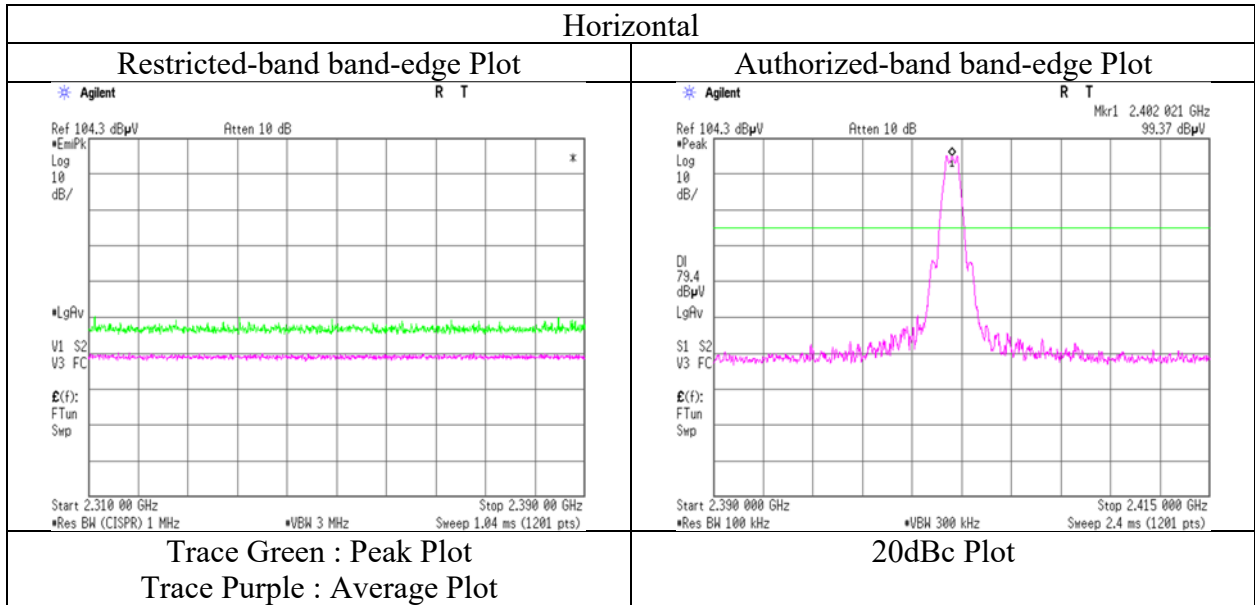
### 20 dBc Data Sheet (RBW 100 kHz, VBW 300 kHz)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.000	PK	99.40	27.53	13.44	46.20	3.52	97.69	-	-	Carrier
Hori.	2400.000	PK	52.00	27.52	13.44	46.20	3.52	50.28	77.69	27.4	
Vert.	2402.000	PK	97.20	27.53	13.44	46.20	3.52	95.49	-	-	Carrier
Vert.	2400.000	PK	50.60	27.52	13.44	46.20	3.52	48.88	75.49	26.6	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor  
 Distance factor : 1 GHz - 10 GHz :  $20\log(4.5\text{ m} / 3.0\text{ m}) = 3.52\text{ dB}$

**Radiated Spurious Emission**  
**(Reference Plot for band-edge)**

Test place	Kashima EMC Lab.
Semi Anechoic Chamber	No.10
Date	October 14, 2022
Temperature / Humidity	21 deg. C / 58 % RH
Engineer	Hiromitsu Tanabe
	(1 GHz - 2.8 GHz)
Mode	Tx BLE 1M-PHY 2402 MHz



\* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions. Final result of restricted band edge was shown in tabular data.

## Radiated Spurious Emission

Test place	Kashima EMC Lab.
Semi Anechoic Chamber	No.10
Date	October 14, 2022
Temperature / Humidity	21 deg. C / 58 % RH
Engineer	Hirimitsu Tanabe (1 GHz - 2.8 GHz)
Mode	Tx BLE 1M-PHY 2480 MHz

(\* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	2483.500	PK	59.50	27.87	13.51	46.12	3.52	58.28	73.9	15.6	153	241	
Vert.	2483.500	PK	58.20	27.87	13.51	46.12	3.52	56.98	73.9	16.9	149	121	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor  
 Distance factor : 1 GHz - 10 GHz :  $20\log(4.5\text{ m} / 3.0\text{ m}) = 3.52\text{ dB}$

### Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2483.500	AV	45.20	27.87	13.51	46.12	0.93	3.52	44.91	53.9	8.9	*1)
Vert.	2483.500	AV	44.80	27.87	13.51	46.12	0.93	3.52	44.51	53.9	9.3	*1)

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + Distance factor

Distance factor : 1 GHz - 10 GHz :  $20\log(4.5\text{ m} / 3.0\text{ m}) = 3.52\text{ dB}$

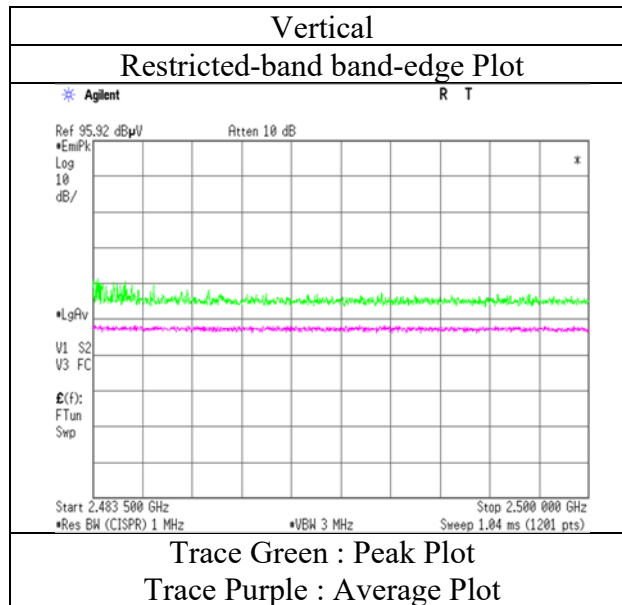
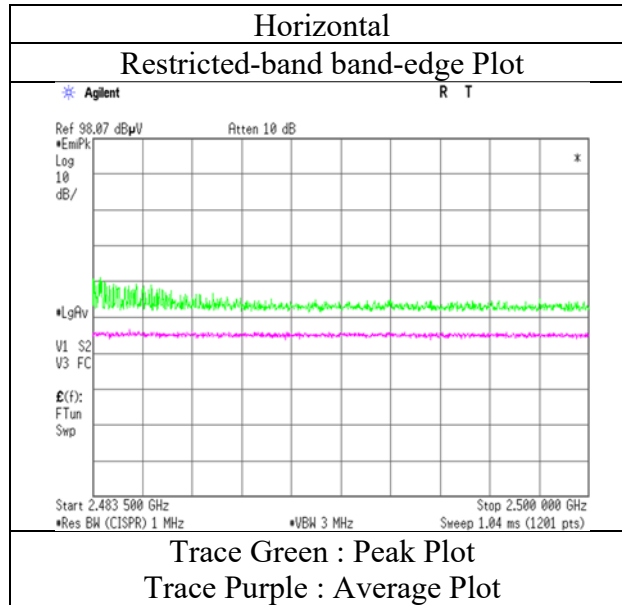
Duty factor refer to "Duty factor Calculation chart" sheet.

\*1) Not out of band emission (Leakage Power)



**Radiated Spurious Emission**  
**(Reference Plot for band-edge)**

Test place	Kashima EMC Lab.
Semi Anechoic Chamber	No.10
Date	October 14, 2022
Temperature / Humidity	21 deg. C / 58 % RH
Engineer	Hiromitsu Tanabe
	(1 GHz - 2.8 GHz)
Mode	Tx BLE 1M-PHY 2480 MHz



\* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions. Final result of restricted band edge was shown in tabular data.

## Radiated Spurious Emission

Test place	Kashima EMC Lab.
Semi Anechoic Chamber	No.10
Date	October 14, 2022
Temperature / Humidity	21 deg. C / 58 % RH
Engineer	Hikomitsu Tanabe (1 GHz - 2.8 GHz)
Mode	Tx BLE 2M-PHY 2402 MHz

(\* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	2390.000	PK	55.50	27.50	13.43	46.21	3.52	53.74	73.9	20.1	196	246	
Vert.	2390.000	PK	55.70	27.50	13.43	46.21	3.52	53.94	73.9	19.9	148	46	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor  
 Distance factor : 1 GHz - 10 GHz :  $20\log(4.5\text{ m} / 3.0\text{ m}) = 3.52\text{ dB}$

### Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2390.000	AV	44.50	27.50	13.43	46.21	0.88	3.52	43.62	53.9	10.2	*1)
Vert.	2390.000	AV	44.70	27.50	13.43	46.21	0.88	3.52	43.82	53.9	10.0	*1)

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + Distance factor  
 Distance factor : 1 GHz - 10 GHz :  $20\log(4.5\text{ m} / 3.0\text{ m}) = 3.52\text{ dB}$

Duty factor refer to "Duty factor Calculation chart" sheet.

\*1) Not out of band emission (Leakage Power)

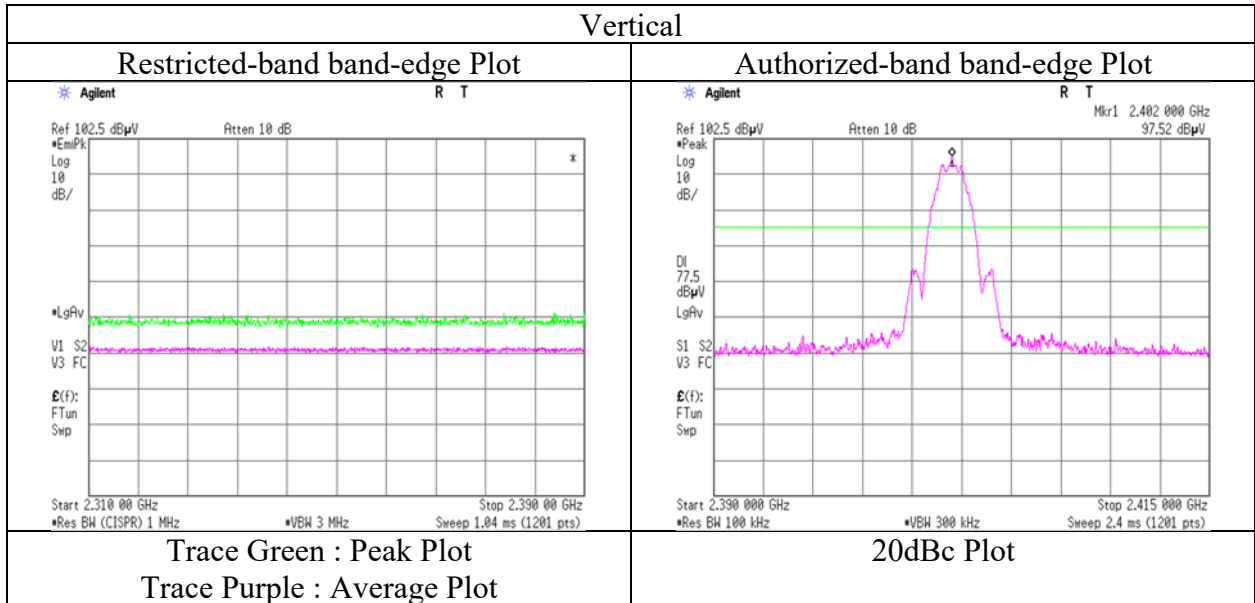
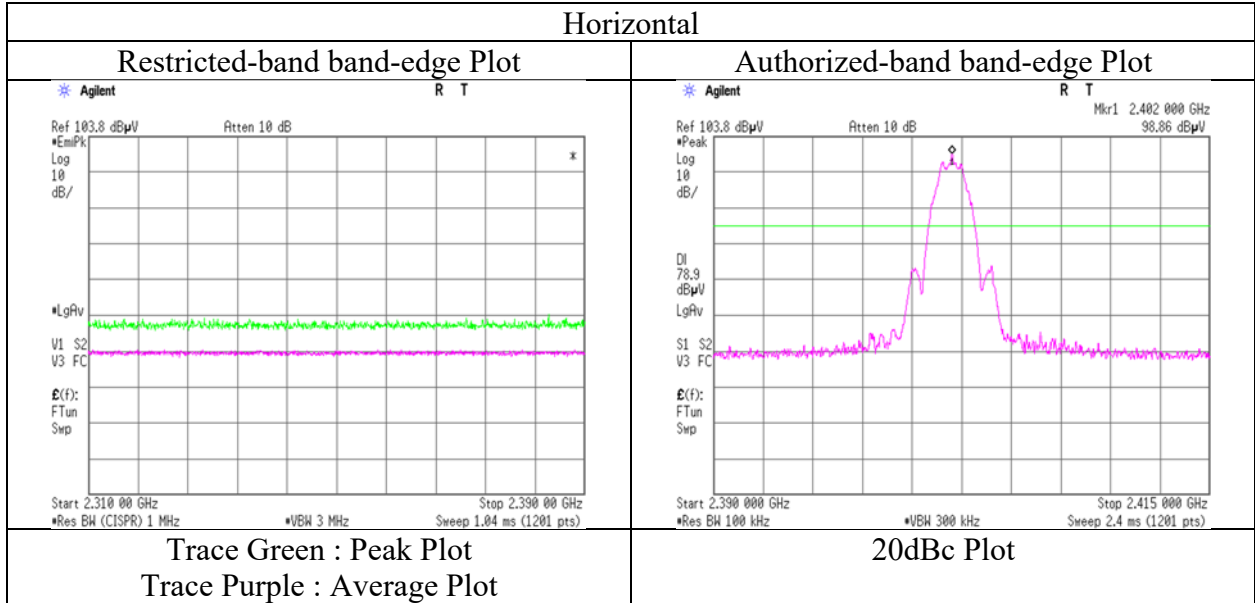
### 20 dBc Data Sheet (RBW 100 kHz, VBW 300 kHz)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.000	PK	98.90	27.53	13.44	46.20	3.52	97.19	-	-	Carrier
Hori.	2400.000	PK	66.80	27.52	13.44	46.20	3.52	65.08	77.19	12.1	
Vert.	2402.000	PK	97.50	27.53	13.44	46.20	3.52	95.79	-	-	Carrier
Vert.	2400.000	PK	65.50	27.52	13.44	46.20	3.52	63.78	75.79	12.0	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor  
 Distance factor : 1 GHz - 10 GHz :  $20\log(4.5\text{ m} / 3.0\text{ m}) = 3.52\text{ dB}$

**Radiated Spurious Emission**  
**(Reference Plot for band-edge)**

Test place	Kashima EMC Lab.
Semi Anechoic Chamber	No.10
Date	October 14, 2022
Temperature / Humidity	21 deg. C / 58 % RH
Engineer	Hiromitsu Tanabe
	(1 GHz - 2.8 GHz)
Mode	Tx BLE 2M-PHY 2402 MHz



\* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions. Final result of restricted band edge was shown in tabular data.

## Radiated Spurious Emission

Test place	Kashima EMC Lab.
Semi Anechoic Chamber	No.10
Date	October 14, 2022
Temperature / Humidity	21 deg. C / 58 % RH
Engineer	Hikomitsu Tanabe (1 GHz - 2.8 GHz)
Mode	Tx BLE 2M-PHY 2480 MHz

(\* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	2483.500	PK	61.00	27.87	13.51	46.12	3.52	59.78	73.9	14.1	151	241	
Vert.	2483.500	PK	58.40	27.87	13.51	46.12	3.52	57.18	73.9	16.7	142	120	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor  
 Distance factor : 1 GHz - 10 GHz :  $20\log(4.5\text{ m} / 3.0\text{ m}) = 3.52\text{ dB}$

### Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2483.500	AV	46.30	27.87	13.51	46.12	0.88	3.52	45.96	53.9	7.9	*1)
Vert.	2483.500	AV	45.10	27.87	13.51	46.12	0.88	3.52	44.76	53.9	9.1	*1)

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + Distance factor

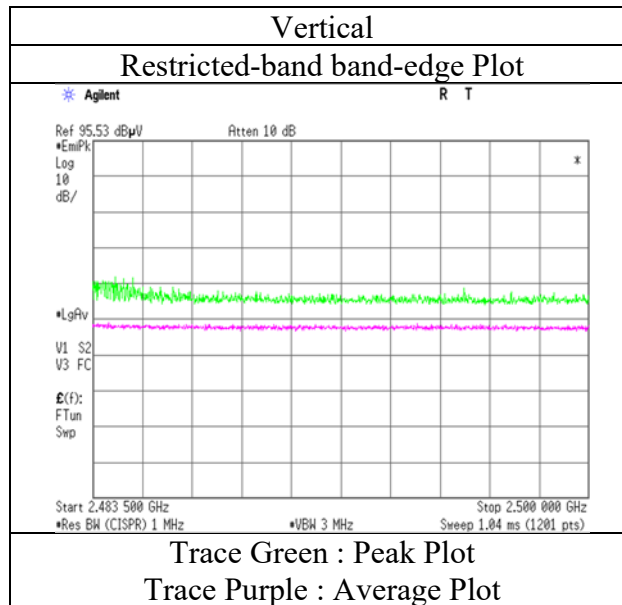
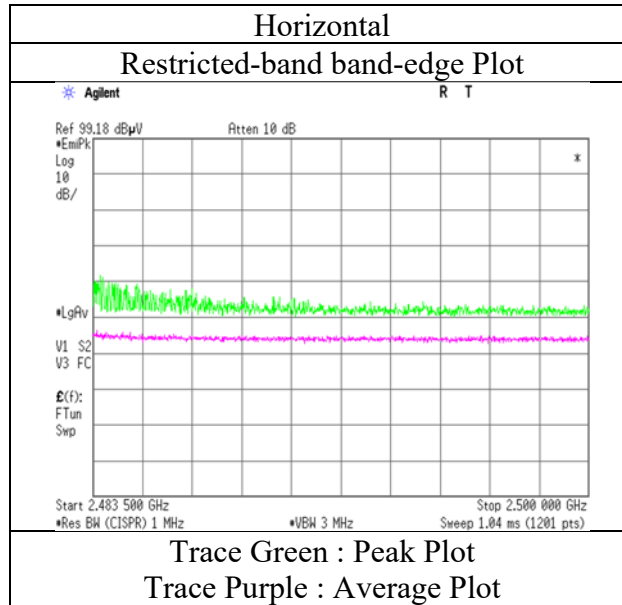
Distance factor : 1 GHz - 10 GHz :  $20\log(4.5\text{ m} / 3.0\text{ m}) = 3.52\text{ dB}$

Duty factor refer to "Duty factor Calculation chart" sheet.

\*1) Not out of band emission (Leakage Power)

**Radiated Spurious Emission**  
**(Reference Plot for band-edge)**

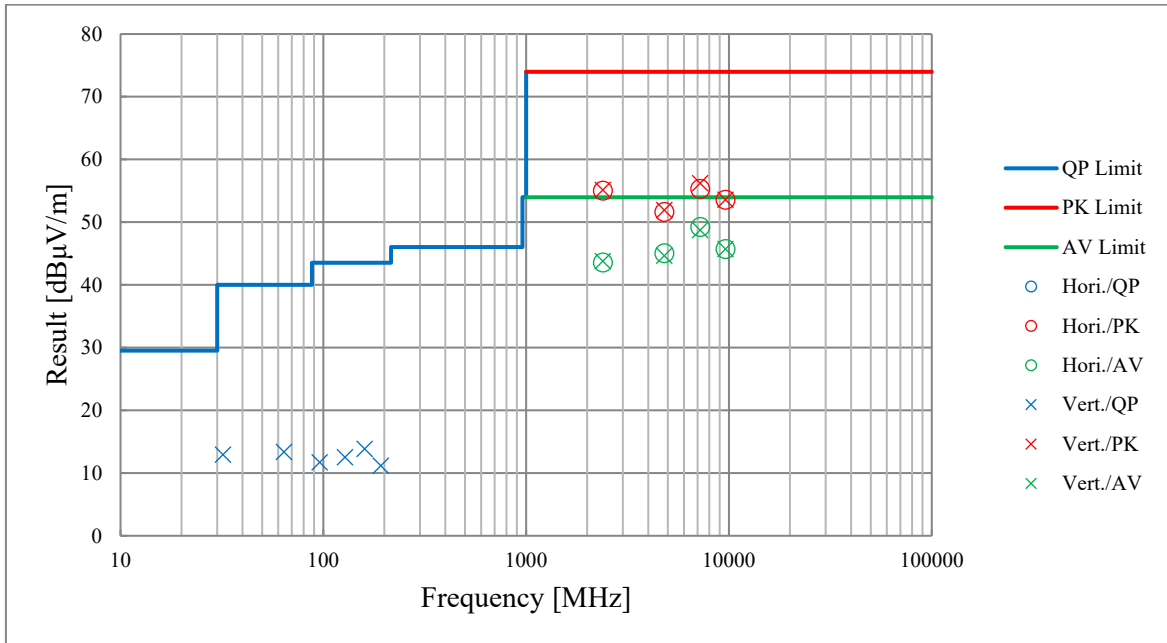
Test place	Kashima EMC Lab.
Semi Anechoic Chamber	No.10
Date	October 14, 2022
Temperature / Humidity	21 deg. C / 58 % RH
Engineer	Hiromitsu Tanabe
	(1 GHz - 2.8 GHz)
Mode	Tx BLE 2M-PHY 2480 MHz



\* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions. Final result of restricted band edge was shown in tabular data.

**Radiated Spurious Emission**  
**(Plot data, Worst case mode for Maximum Peak Output Power)**

Test place	Kashima EMC Lab.			
Semi Anechoic Chamber	No.10	No.10	No.10	No.10
Date	October 14, 2022	October 14, 2022	October 14, 2022	October 14, 2022
Temperature / Humidity	21 deg. C / 58 % RH	21 deg. C / 58 % RH	21 deg. C / 58 % RH	21 deg. C / 58 % RH
Engineer	Hiromitsu Tanabe	Hiromitsu Tanabe	Hiromitsu Tanabe	Hiromitsu Tanabe
Mode	(30 MHz - 1000 MHz) Tx ANT 2402 MHz	(1 GHz - 2.8 GHz)	(2.8 GHz - 10 GHz)	(10 GHz - 26.5 GHz)



\*These plots data contains sufficient number to show the trend of characteristic features for EUT.

## APPENDIX 2: Test Instruments

### Test Equipment

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
RE	CBL-08	143121	LOGBICON	Schwarzbeck Mess-Elektronik OHG	VULB 9168	343	2022/04/18	12
RE	CAT5-03	178806	5dB Fixed Atten.	Pasternack Enterprises	PE7047-5	none	2022/04/01	12
RE	CCC-S10-R3	143165	10 Site RE 3m System	UL Japan	none	none	2022/08/27	12
RE	CAF-28	183880	Pre-Amplifier	Mini-Circuits	ZKL-2	001	2022/04/06	12
RE	CTR-09	144199	Test Receiver	Keysight Technologies Inc	N9038A	MY53290016	2022/07/21	12
RE	CAEC-10(NSA)	144632	Semi Anechoic Chamber	TDK	NSA (No.10)	10	2022/05/15	12
RE	CSCL-26	222745	Measure	SHINWA RULES CO., LTD.	80862	none	-	-
RE	COS-10	143542	Temperature & Humidity Indicator	HIOKI E.E. CORPORATION	3641/9680-50	090999895/ 090905406	2022/06/20	12
RE	CBM-10	143133	Barometer	Sanoh Co., Ltd	SBR-151	001439	2021/11/24	36
RE	CTS-14	144216	Digital Multimeter	Duke Corporation	115	994460954	2021/10/20	12
RE	COTS-CEMI-03	178804	EMI Software	TSJ (Techno Science Japan)	TEPTO-DV3(RE,CE,ME,PE)	Ver 3.1.0484	-	-
RE	CSA-07	143643	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY52490024	2022/06/23	12
RE	TSA-01	143642	Spectrum Analyzer	Keysight Technologies Inc	N9030A	MY53310670 Version A.13.12	2022/05/25	12
RE	CCC-G14	192241	Microwave Cable	Huber+Suhner	SF104/PC35m/PC35m/1000mm	805411/4	2022/01/18	12
RE	CCC-G17	192244	Microwave Cable	Huber+Suhner	SF104/11N/11PC35/8000MM	808996/4	2022/01/18	12
RE	CAT10-17	143023	10dB Fixed Atten.	Weinschel - API Technologies Corp	54A-10	56251	2022/05/30	12
RE	CHF-04	143442	HPF	MICRO-TRONICS	HPM50111-02	009	2022/05/30	12
RE	TPA-14	175395	Pre Amplifier	Erzia Technologies S.L.	ERZ-LNA-0100-2700-45-4	16A2001702002	2021/12/07	12
RE	CHA-24	143455	Double Ridged Wave Guide	ETS-Lindgren (Cedar Park, Texas)	3115	00204569	2022/02/05	12
RE	CHA-07	143438	Double Ridged Horn	ETS-Lindgren (Cedar Park, Texas)	3160-09	00166043	2022/06/18	12
RE	CAF-19	142937	Pre-Amplifier	TOYO	HAP18-26W	00000035	2022/06/18	12
RE	CCC-W10	142992	Micro Wave Cable	Suhner	SUCOFLEX102	MY010/2A	2022/08/03	12

\*Hyphens for Last Calibration Date and Cal Int (month) are instruments that Calibration is not required (e.g. software), or instruments checked in advance before use.

The expiration date of the calibration is the end of the expired month.

As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.

All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

Test item: RE: Radiated Emission